Service Manual

FILE No.

Biomedical Freezer

MDF-137

SANYO Electric Co., Ltd.
Biomedical Business Division

RoHS

This product does not contain any hazardous substances prohibited by the RoHS Directive.
(You will find 'RSF' mark near the rating plate on the RoHS compliant product.)

WARNING

* You are requested to use RoHS compliant parts for maintenance or repair.
* You are requested to use lead-free solder.

SM9910202

Effective models

This service manual is effective following models.

Model name	Product code	Voltage and Frequency
MDF-137	823 016 54	220-240V 50Hz

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Features

■ Cooling performance
- New compressor realizes chamber temperature can maintain -30℃ at least when ambient temperature is 35℃.

■ Environment conscious
- HFC refrigerant, R-134a is adopted.
- CP urethane foaming is adopted for frame insulation.

■ Better reliability for storage
- Various function modes are added by flash memory.
- Battery age is informed by counting battery accumulation time.
- Delay time for temperature alarm is changeable.
- New door lock mechanism

Specifications

■Structural specifications

Item	Specifications
Name	Biomedical Freezer
Model	MDF-137
External dimensions	W640 x D687 x H881 mm
Internal dimensions	W525 x D440 x H715 mm
Effective capacity	138 L
Exterior	Painted steel
Interior	Colored aluminum plate
Insulation	Rigid polyurethane foamed-in place
Door	Painted steel
Lock	1 pc, cylinder type
Compressor	Hermetic type, Output: 150W
Evaporator	Aluminum tube on sheet type
Condenser	Wire and tube type
Refrigerant	R-134a
Battery	For power failure alarm, Nickel-metal-hydride battery, DC6V, 1100mAh Automatic charge
Accessories	1 set of key, 1 scraper, 2 baskets
Caster	4 pcs
Leveling foot	2 pcs at front
Access port	ϕ17mm at right side and bottom left
Weight	52 Kg
Optional components	Automatic temperature recorder: MTR-4015LH, MTR-G85 Mounting kit for automatic temperature recorder: MDF-S3040 (for MTR-4015LH) MDF-S740（for MTR-G85） 2 baskets: MDF-13B2 MTR-480C MTR-L03 MTR-5000

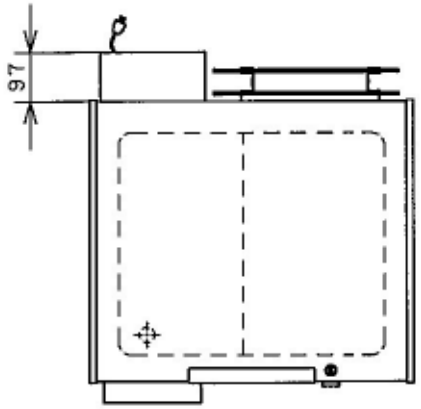
■Performance specifications

Item	Specifications		
Cooling performance	-30℃（AT:35℃, no load）		
Temperature control range	-20～-30℃		
Rated voltage	AC220V	AC230V	AC240V
Rated frequency	50Hz	50Hz	50Hz
Rated power consumption	95W	100W	100W
Noise level	35 dB <A> (background noise; 20dB)		
Maximum pressure	1.64 MPa		

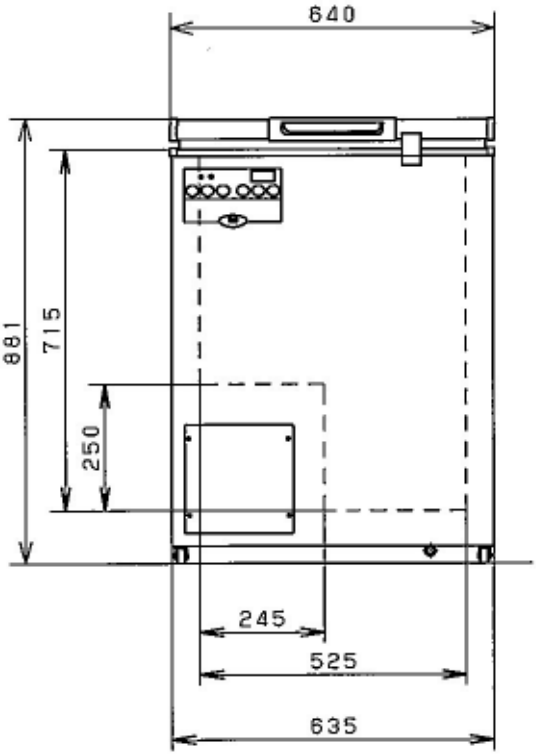
■Control specifications

Item		Specifications
Temp. controller		Microcomputer input by keypad Setting range: -18℃～-35℃（1℃ increment） Non-volatile memory
Temp. sensor		Thermistor sensor
Temp. display		LED digital display (1℃ increment) Display range: -50℃～50℃
Alarms	High temp.	Set temperature＋5～+15℃, changeable（Default: +10℃） ALARM lamp blinks and buzzer sounds intermittently with 15 min. of delay Remote alarm contact activates and joins with buzzer
	Low temp.	Set temperature-5～-15℃, changeable（Default: -10℃） ALARM lamp blinks and buzzer sounds intermittently with 15 min. of delay Remote alarm contact activates and joins with buzzer
	Remote alarm	Remote alarm terminal 3P: Contact capacity DC30V, 2A (Max) NC-COM、NO-COM Activates during high/low temp. alarm, power failure alarm and Alarm test performed, joins with buzzer
	Power fail.	ALARM lamp blinks, buzzer sounds intermittently and remote alarm contact activates.
Control panel		ALARM: Alarm lamp BUZZER: Alarm buzzer stop key ALARM TEST: Alarm test key SET: Set key ＞: Digit shift key ∧: Numerical value shift key DEF: Defrost key
Key Lock		Press ＞ key for 5 seconds. L0: Unlocked L1: Locked
Self diagnosis		* When temp. sensor is failed; - Error code（E01/E02） and chamber temp. are displayed alternately. - Remote alarm contact activates with buzzer sounds. * When battery switch OFF check is failed in Alarm Test; - Error code（E09） and chamber temp. are displayed alternately.
Power switch		Breaker switch on left back side
Power source		Local voltage

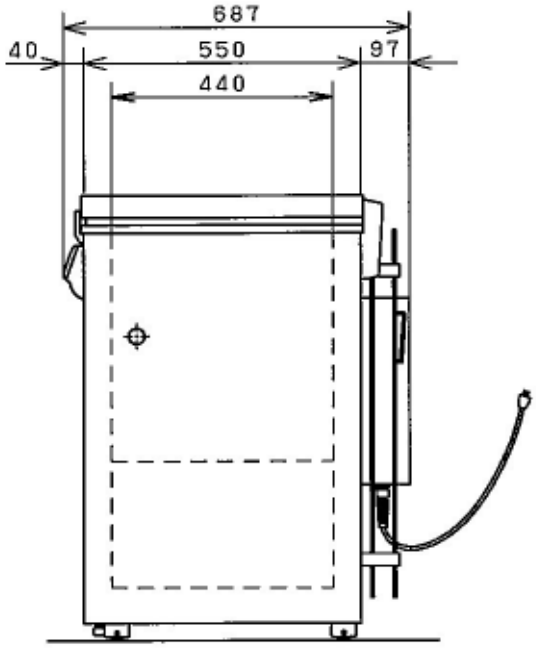
Dimensions



Ceiling



Front



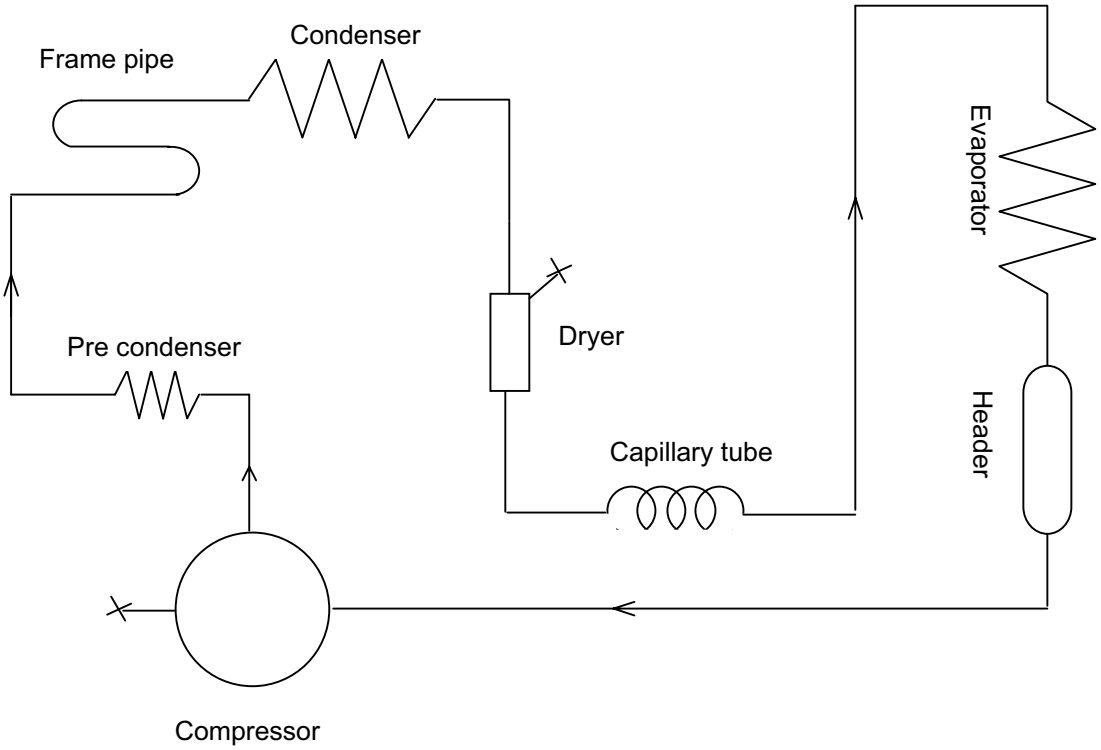
Side

Cooling unit parts

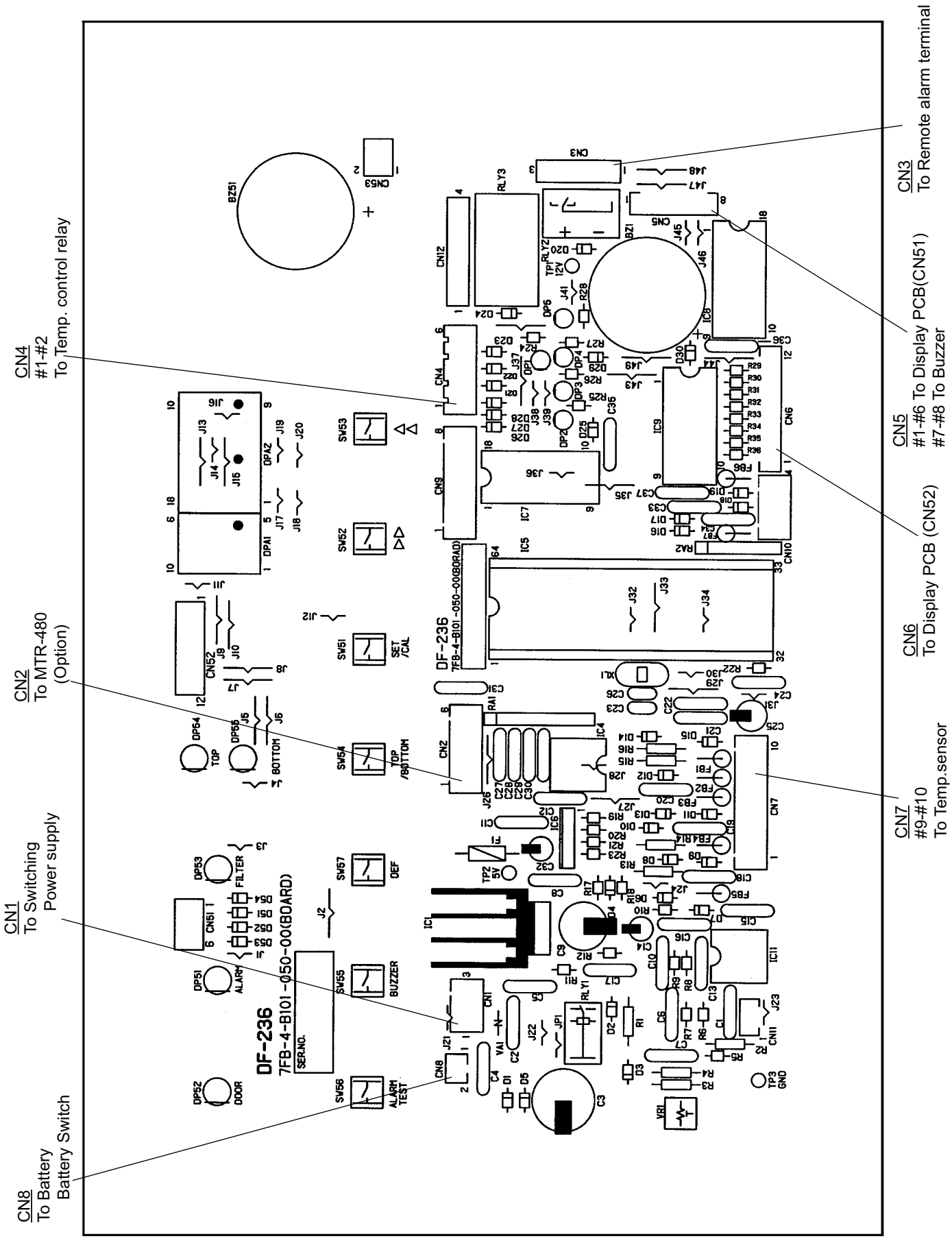
MDF-137

Parts name	Specifications	
Compressor	Type	FL1568-SP
	Compressor cord	7FB-2-M101-010-03
	Rated power supply	Single phase, 220~240V, 50Hz
	Oil	Charged q'ty: 310±10ml
	Cooling method	Natural air circulation
	PTC	PGR0SAT
	Overload relay	2.0C36C3
	Starting capacitor	60μF-300VAC
	Running capacitor	-----
Evaporator	Type	Direct cooling tube on sheet type
Dryer	Type	4A-XH-9
	Charged q'ty	10g
Capillary tube	Resistance	0.725 MPaG
	Length(L)	3600 mm
	Outer diameter(OD)	ϕ1.8 mm
	Inner diameter(ID)	(ϕ0.65 mm)
Condenser	Type	Natural convection
	Condenser	Wire and tube type 24 lines × P40mm × W440 mm
	Pre-condenser	Wire and tube type 4 lines × P40mm × W440 mm
	Frame pipe	ϕ4.76、C1220T
Refrigerant	Type	R-134a Charged q'ty: 160±5g

Refrigeration circuits



Components on PCB



Connections on PCB

Connectors on Temp. control PCB

Connector	Connects to	Usage
CN1	Switching power supply ＃1 +12VDC ＃3 GND	To supply the power to PCB
CN2	MTR-480（Option）	
CN3	Remote alarm terminal ＃1 COM ＃2 N.C.(When power is not supplied) ＃3 N.O.(When power is not supplied)	Output for remote alarm contact ・Open between #1 and #2 when the power is supplied in normal condition. ・#1 and #2 are connected with remote alarm terminal.
CN4	Temp. control relay #1: +12V (When temp. control relay is ON) #2: GND	To turn temp. control relay on/off
CN5	Display PCB (CN51)	To connect with each of switches
CN6	Display PCB (CN52)	To connect with each of LED
CN7	Temp. sensor #9 - #10 Temp. sensor	To sense chamber temperature
CN8	Battery（6V）	To connect with battery for power failure

Electric parts

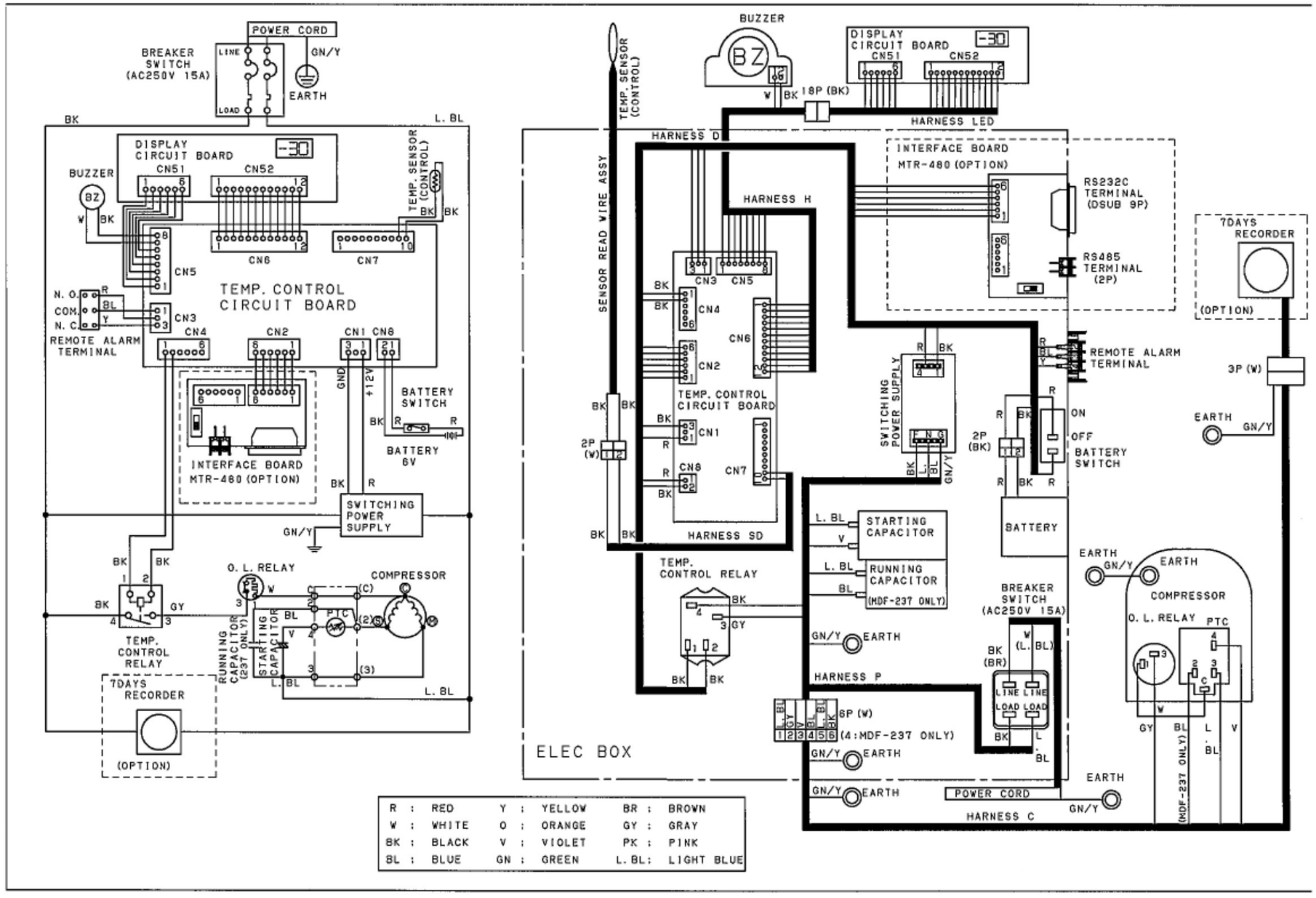
MDF-137		220~240V, 50Hz
Compressor	Type	FL1568-SP
	Compressor cord	7FB-2-M101-010-03
	Rating	220~240V, 50Hz
	Winding resistance(25℃) C-R	11.4Ω
	C-S	19.5Ω
PTC	Type	PGR0SAT
	Resistance（25℃）	33±6.6Ω
O.L. relay	Type	2.0C36C3
	Action to the temp.	ON:130 $^{+8}_{-9}$ ℃ OFF:60 $^{+7}_{-5}$ ℃
	Action to the current (AT25℃)	7.6 A
	Non-action to the temp.	
	Operation time	10 sec
Starting capacitor	Rating	60μF, 300VAC
Temp. control relay	Type	G4F-11123T
	Contact capacity	20A
	Coil	12VDC
Temp. sensor	Type	502AT-1
	Rating	5KΩ, 25℃
Switching power supply	Type	LDA10F-12
	Rated output	12VDC, 0.9A
Breaker switch	Type	BAM215131
	Rating	250VAC, 15A
Battery switch	Type	SLE6A2-5
	Rating	250VAC, 4A
Battery	Type	5HR-AAC(Ni-MH)
	Rating	6V, 1100mAH

Specifications of sensor

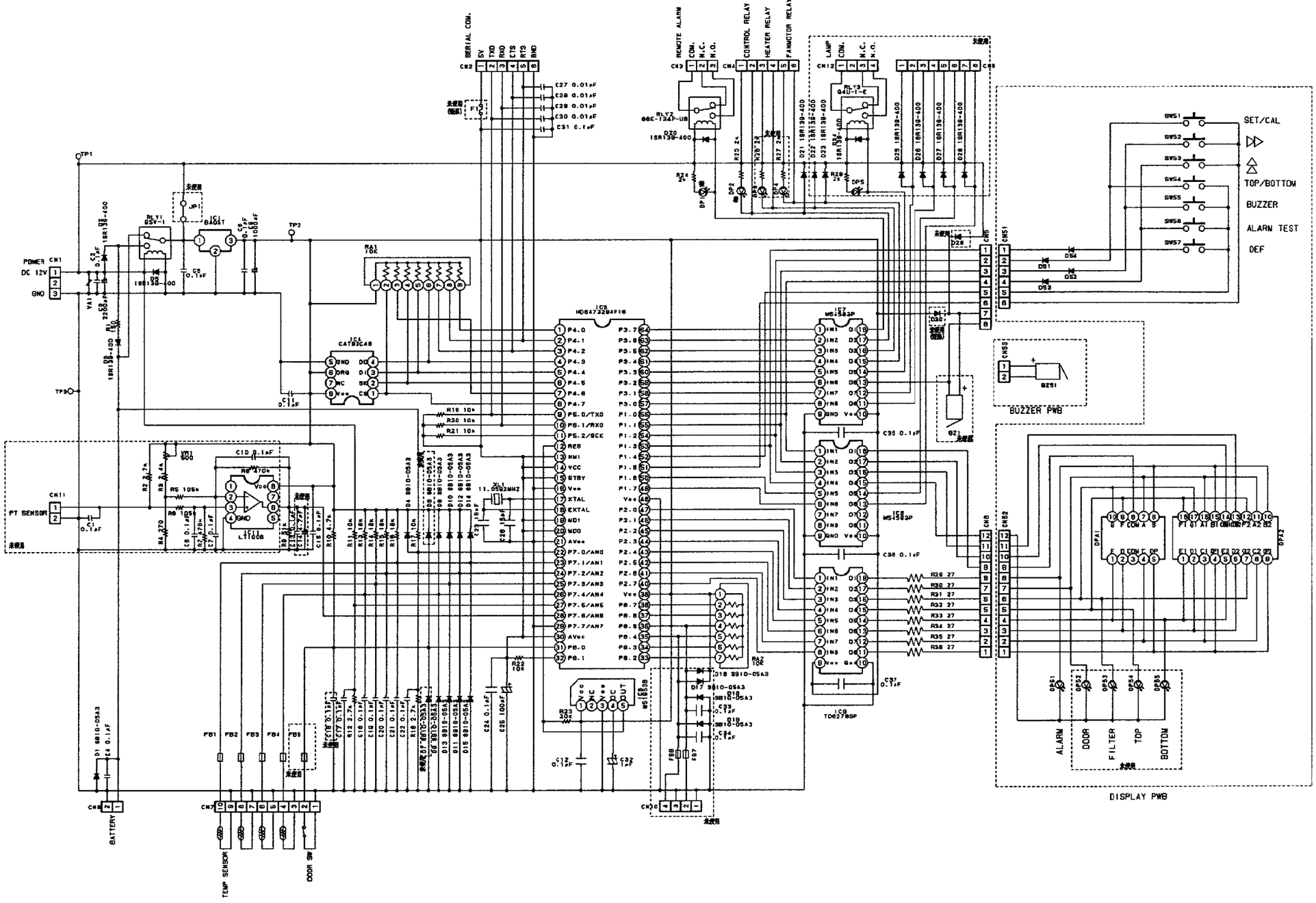
Type: 502AT-1

℃	kΩ	℃	kΩ	℃	kΩ	℃	kΩ
−50	154.5	−36	71.80	−22	35.65	0	13.29
−49	145.9	−35	68.15	−21	33.99	5	10.80
−48	137.8	−34	64.71	−20	32.43	10	8.84
−47	130.2	−33	61.48	−19	30.92	15	7.20
−46	123.1	−32	58.43	−18	29.50	20	6.01
−45	116.5	−31	55.55	−17	28.14	25	5.00
−44	110.2	−30	52.84	−16	26.87	30	4.17
−43	104.4	−29	50.23	−15	25.65	35	3.50
−42	98.87	−28	47.77	−14	24.51	40	2.96
−41	93.70	−27	45.45	−13	23.42	45	2.51
−40	88.85	−26	43.26	−12	22.39	50	2.13
−39	84.18	−25	41.19	−11	21.41	55	1.82
−38	79.80	−24	39.24	−10	20.48	60	1.56
−37	75.67	−23	37.39	−5	16.43	65	1.35

Wiring Diagram



Circuit diagram



Control specifications

1. Keys and Switches

BUZZER : When alarm lamp blinks and buzzer sounds, buzzer and remote alarm output …… Forced to be turned off
Buzzer is not turned off during alarm test.
When alarm lamp blinks and buzzer is turned off, buzzer never activates.
In power failure, press the key to display the current temperature for 5 seconds.

SET : Press once this key to enter into setting mode with 2nd digit blinks.
Press this key again to memorize the value. (it works as ENTER key)

DEF : In chamber temperature display, press this key for 5 seconds to start defrosting.
In defrosting, press this key to have defrosting to the end.
In defrosting, chamber temperature and "dF" are displayed alternately.
In defrosting, temperature alarm is cancelled.
When the sensor error is occurred In defrosting, error code and chamber temperature are displayed alternately. "dF" is gone off.
In defrosting, only the buzzer key is operative.

ALARM TEST : In chamber temperature display, press the key for 5 seconds to activate alarm test mode. ALARM lamp blinks, buzzer sounds intermittently and the display goes off and remote alarm activates.
Automatically returns to normal condition after 90 seconds passed even if you don't press this key. (Auto Return)
When you perform alarm test with battery switch is off position, 'E09' blinks.

During setting mode, press this key to change the digit one by one. In chamber temperature display, press this key for 5 seconds to enter into Key Lock mode with "L_0" display.

During setting mode, press this key to count the digit up one by one. In chamber temperature display, press this key for 5 seconds to enter into Function mode with "F00" display.
Input each function code by pressing key and key.

2. Temperature control

Setting range : -18℃～-35℃
Display range : -50℃～+50℃
Setting process : Press SET key and set the required value with key and key. Press SET key again to memorize the set value, and then automatically return to chamber temperature display.
Unacceptable setting range: When you input a value in unacceptable setting range and press SET key, error tone is emitted.

3. Key Lock Function

Setting range : 0 or 1
Setting process In chamber temperature display, press key for 5seconds to enter into Key Lock mode with "L_0" display. Change the 1st digit and press SET key to memorize the value in non-volatile memory.

1: Locked
0: Unlocked

4. Function mode

Setting range : 0~50
Display range : 0~59
Note) 04, 08, 13, 15, 16, 18~20, 26~29, 31, 33~49 are unused.
Setting process : In chamber temperature display, press ⏫ key for 5 seconds to enter into Function mode with 'F00' display. Change the 1st digit with ⏫ key and ⏩ key.
Unacceptable setting range: When you input a value in unacceptable setting range and press SET key, error tone is emitted.

5. Error code

E01: Temp. sensor is disconnected.
When temp. sensor is disconnected, 'E01' and '50' are displayed alternately.
Buzzer sounds and remote alarm activates.
Compressor is turned on.
Press BUZZER key to stop buzzer sounding.
Remote alarm keeps activating.

E02: Temp. sensor is short circuited.
When temp. sensor is short circuited, 'E02' and '-50' are displayed alternately.
Buzzer sounds and remote alarm activates.
Compressor is turned on.
Press BUZZER key to stop buzzer sounding.
Remote alarm keeps activating.

E09: Battery switch is OFF
When battery switch is off position or battery is unconnected, press ALARM key to display 'E09'.

6. Alarms

High temp. alarm : When chamber temperature is equal or higher than setting temperature + high temp. alarm setting temperature + 1.0, ALARM lamp and the digital display blink. After 10min. later, buzzer sounds and remote alarm output activates.
When chamber temperature is equal or lower than setting temperature, ALARM lamp and the digital display go off, buzzer stops sounding and remote alarm output turns off.
If you press BUZZER key, buzzer stops sounding. Remote alarm keeps activating.

High temp. alarm setting range: '005' ~ '015'
Default setting: '010'

Low temp. alarm : When chamber temperature is equal or lower than setting temperature - low temp. alarm setting temperature - 1.0, ALARM lamp and the digital display blink. After 10min. later, buzzer sounds and remote alarm output activates.
When chamber temperature is equal or higher than setting temperature, ALARM lamp and the digital display go off, buzzer stops sounding and remote alarm output turns off.
If you press BUZZER key, buzzer stops sounding. Remote alarm keeps activating.

Low temp. alarm setting range: '-05' ~ '-15'
Default setting: '-10'

Power failure alarm : When power switch is off position or power is not supplied for 3 seconds with battery switch ON, ALARM lamp blinks, buzzer sounds intermittently and remote alarm activates.
When the power is retrieved within 3 seconds since the power failed, the apparatus restarts with initial operation.
Remote alarm turns off.
Press BUZZER key to stop buzzer sounding.
Remote alarm keeps activating.
Remote alarm keeps activating until chamber temperature is stabled after the power retrieves from power failure.
If you press BUZZER key during power failure, you can check chamber temperature for 5 seconds.

7. Auto Return

If there are not any key operations for 90 seconds in setting mode, Key Lock mode and Function mode, the value would not be memorized and automatically returns to chamber temperature display.

8. Alarm resume time (Ring Back)

Buzzer sounds again after alarm resume time elapses even if someone intends to stop buzzer sounding by pressing BUZZER key during alarm condition.
Alarm resume time is changeable in F25.

9. Temperature in temp. sensor

The 1st decimal point of the temperature in temp. sensor is displayed in F12.
Ex) -30.2℃ => Displayed as '30.2'

10. Battery accumulation period

Battery accumulation period is displayed in F03.
Ex) 2 years and 6 months => Displayed as '02.5'

When battery accumulation period is '02.8', 'F-1' and chamber temperature are displayed alternately.

How to reset battery accumulation period:
Input '409' in F06 and press SET key to clear accumulation period to '00.0'.
'F-1' is disappeared on the display.

11. ROM version

Current ROM version is displayed in F30.
Ex) Ver. 1.00 => Displayed as '1.00'

12. Function mode

Function modes are as follow.

F00: Automatically return to chamber temperature display
F01: Setting of temperature for high temperature alarm
F02: Setting of temperature for low temperature alarm
F03: Display of Battery accumulation period
F05: Setting of compressor delay time
F06: Service code input (384)
F07: Temperature Zero calibration
F12: Display of temperature in temperature sensor (The decimal point is displayed)
F17: Setting of model code (Initialization for non-volatile memory)
F21: Setting of communication ID
F22: Setting of communication mode
F24: Joint operation for remote alarm and buzzer
F25: Setting of alarm resume time (Ring Back)
F26: Display of running rate
F30: Display of ROM version
F50: Setting of temperature alarm delay time

Setting process: In chamber temperature display, press ⏫ key for 5seconds to display "F00".
Press ⏩ key to input required function code and press SET key.

Note) Ensure to input service code '384' in F06 prior to use F07, F12, F17, F24, F26 and F30. It is unnecessary to input service code when you use F00~F06, F21, F22 and F25.
Service code '384' is cancelled if you input '000' in F06 or turn the power off

F00: It is not functioned. In F00 displayed, press SET key to return to chamber temperature display.

F01: Setting of temperature for high temp. alarm
Setting range is '005' ~ '015'
Input F01 and press SET key to display '010' (Default setting).
Change to your required value and press SET key to memorize and return to chamber temperature display.

F02: Setting of temperature for low temp. alarm
Setting range is '-05' ~ '-15'
Input F02 and press SET key to display '-10' (Default setting).
Change to your required value and press SET key to memorize and return to chamber temperature display.

F03: Display of battery accumulation period
Input F03 and press SET key to display F03 and battery accumulation period alternately. Press SET key to return to chamber temperature display.
'00.0' = Battery accumulation period is less than 36days

F05: Setting of compressor delay time (This function is performed when the main power is turned on or power is retrieved from power failure)
Setting range is '003'~'015'.
Press SET key to memorize the value and return to chamber temperature display.

F06: Input F06 and press SET key to display '000' (default setting).
Input the service code with ⏫ key and ⏩ key. (Service code: 384)
press SET key to memorize service code and return to chamber temperature display.

<Reset of battery accumulation time>
Input service code, 384 and '409' to reset battery accumulation time.
Return to chamber temperature display.

If you want to cancel the service code, input F06 to display '384'.
Change the value to '000' with ⏫ key and ⏩key.
If you turn the power off then on, the display is also returned to '000'.

F07: Zero Adjustment of temperature sensor (setting range: -4.9℃~+04.9℃)
This function is used for adjustment between display temperature and 1/2H air temperature.

In "F07" displayed, press SET key to display "00.0"(default setting), then change the value with ⏫ key and ⏩ key. Press again SET key to memorize the value.

<How to adjust display temperature and 1/2H air temperature>
When the actual 1/2H air temperature is -26℃ and setting temperature is –30℃, input F07 and press SET key to display '00.0'.
Change the value to '04.0' and press SET key.
About 4℃ is added to display temperature and chamber temperature is gradually lowered to -30℃.

F12: Display of temperature in temperature sensor
Input F12 and press SET key to display F12 and 'XX.X' (current chamber temperature) alternately. Press SET key to revert to chamber temperature display.
It is not shown "-" (minus) when the temperature is lower than -20.0℃.
(Ex. Actual temp -20.5℃ → Display shows as '20.5')

F17: Setting of model code (001: MDF-137)
In "F17" displayed, press SET key to display model code '001'.
Press SET key again to memorize the value.
<Initialization of non-volatile memory>

Zero adjustment value for temp. sensor	: -30℃
Alarm resume (Ring Back) time	: 30 minutes
Setting temperature	: -30℃
Setting temp. for high temp. alarm	: +10℃
Setting temp. for low temp. alarm	: -10℃
Joint operation for remote alarm and buzzer	: Not joined
Compressor delay time	: 3 minutes
Communication ID	: 000
Communication mode	: 000
Delay time for temp. alarm	: 15 minutes
Key Lock	: OFF

F21: Serial communication ID setting (Range: 000~255)
Input F21 and press SET key to display '000' (default value).
Press SET key to memorize the value and return to chamber temperature display.
<Serial communication data>

Data	Display value
Chamber temperature	: -73.3 ~ +78.4℃
Temperature in comp. sensor	: -70.8 ~ +159.5℃
Compressor operation	: 0(OFF) / 100(ON)
Power failure	: 0(OFF) / 100(ON)
Operation ratio	: 0~100, 222 %
2H timer count	: 0~120 minutes
8H timer count	: 0~480 minutes
Setting temperature	: -35.0 ~ -18.0℃
High temp. alarm setting temp.	: +5.0~+15.0℃
Low temp. alarm setting temp.	: -5.0~-15.0℃
High temp. alarm operation	: 0(OFF) / 50(ON)
Low temp. alarm operation	: 0(OFF) / 50(ON)
Remote alarm operation	: 0(OFF) / 50(ON)
Range for changing chamber temp.	: -25.0~-18.0℃

F22: Serial communication mode setting

Control mode (3rd digit)	0:	Local (initial value)
	1:	Remote
Baud rate (2nd digit)	0:	2400 bps (initial value)
	1:	4800 bps
	2:	9600 bps

1st digit is not used.
Note) It is unable to change setting temperature when you set control mode at "remote".

F24: Joint operation for remote alarm and buzzer
Input F24 and press SET key to display '000' (default setting).
Change to your required setting by ⏫ key.
Press SET key again to revert to chamber temperature display.
000: Not joined
001: Joined

F25: Setting of alarm resume time (Ring Back)
Input F25 and press SET key to display '030' (default setting).
Change to your required setting by ⏫ key. Range: 000~060
Press SET key again to revert to chamber temperature display.

000: Not resumed	040: 40 minutes
010: 10 minutes	050: 50 minutes
020: 20 minutes	060: 60 minutes
030: 30 minutes	

F26: Display of operation ratio
Input F26 and press SET key to display F26 and 'XXX' (current operation ratio) alternately. Press SET key again to revert to chamber temperature display.

F30: Display of ROM version
Input F30 and press SET key to display F30 and 'X.XX' (current ROM version) alternately. Press SET key again to revert to chamber temperature display.

F50: Setting of temperature alarm delay time
Input F50 and press SET key to display '015' (default setting). Change to your required setting by ⏫ key and ⏩ key. Range: 000~015
Press SET key to memorize the value and revert to chamber temperature display.
000: Not delayed

13. Compressor operation for temperature control

When chamber temperature is equal to set temperature : Compressor turns on
When chamber temperature is 0.6℃ lower than set temperature : Compressor turns off

14. Delay time

(1) Compressor delay time (Default: 3 minutes)
Compressor should be started with delay after the power is supplied.
Setting is changeable in F05.
Compressor would not restart next 3 minutes (fixed value) in case it turns off during cycle operation.

(2) Temperature alarm delay time (Default: 10 minutes)
When unit is in high/low temperature alarm condition, buzzer and remote alarm activate with delay time. Display blinks and ALARM lamp is lit without delay.
Setting value is changeable in F50.

15. Temperature offset

Input offset value to adjust for temperature in temp. sensor with actual temperature.
Temp. sensor offset value is -4.0℃.
You can change offset value in F07. (Range: -4.9~+4.9)

16. Display offset

Offset value for display is displayed value -0.5℃.

17. Operation for remote alarm

Connector / Status	CN3	
	#1 - #2 (N.O.)	#1 - #3 (N.C.)
Normal	Open	Close
Alarming	Close	Open

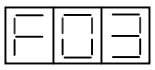
18. Lamp operation

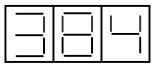
DP51 (Red) on display PCB: ALARM lamp blinks during alarming conditions.
DP1 (Orange) on control PCB: Lit in normal condition
Goes off in high/low temp. alarm (with 15min. delay), in sensor errors, in power failure
DP2 (Green) on control PCB: Lit during compressor operating
Goes off during compressor turns off

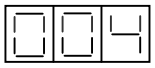
19. Examples of display

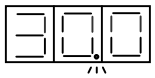
Chamber temp. -29.5℃

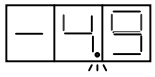
Set temp. -30.0℃

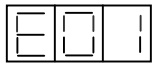
Function code F03 

Service code 384 

Set value 004 

Decimal point of chamber temp. -80.0 

Sensor offset -4.9 

Error E01 

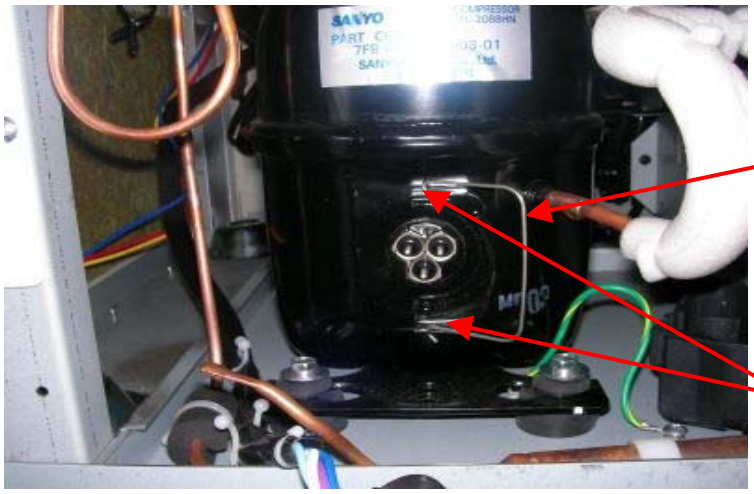
Key Lock L_0

20. Buzzer tone

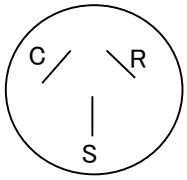
Intermittent tone: In alarming condition
Click tone : In key operation
In memorize setting value
Continuous tone: Ineffective setting value

Installation of compressor terminal cover

(1)

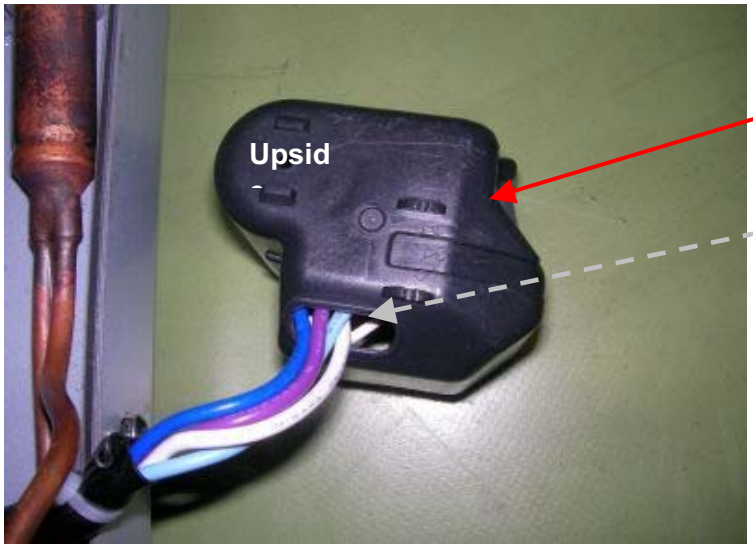


Fixing bar



Hang fixiing bar on the both holes of the terminal. Then move the bar to the right side.

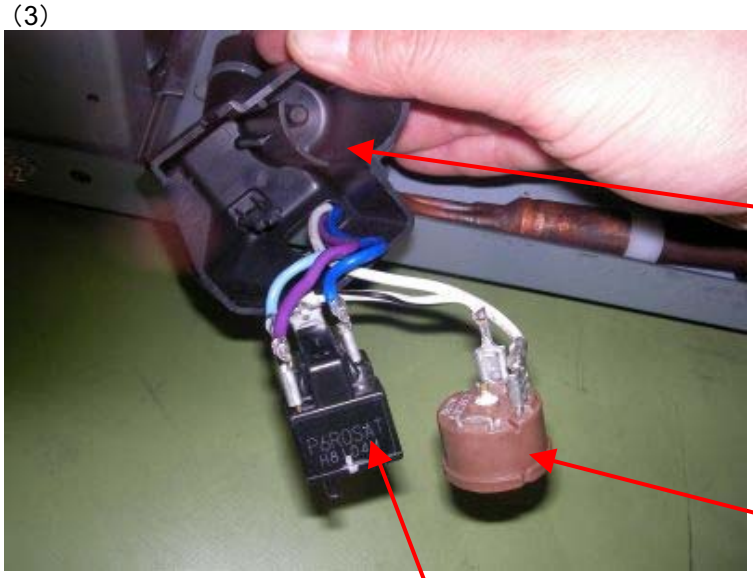
(2)



Terminal cover

Put lead wires into the terminal cover.

(3)



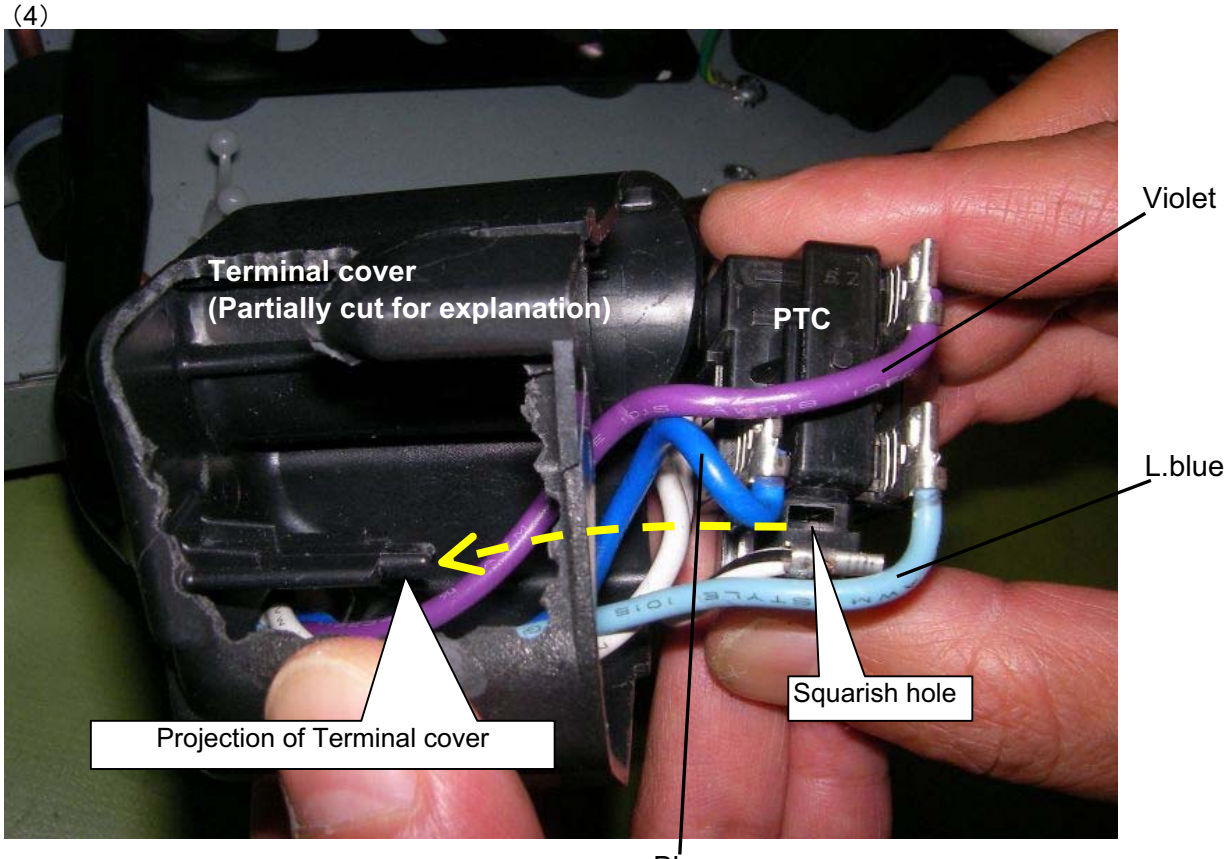
Connect PTC and OLR with the specified color lead wires. (Refer to Wiring diagram)

Terminal cover

OLR

PTC

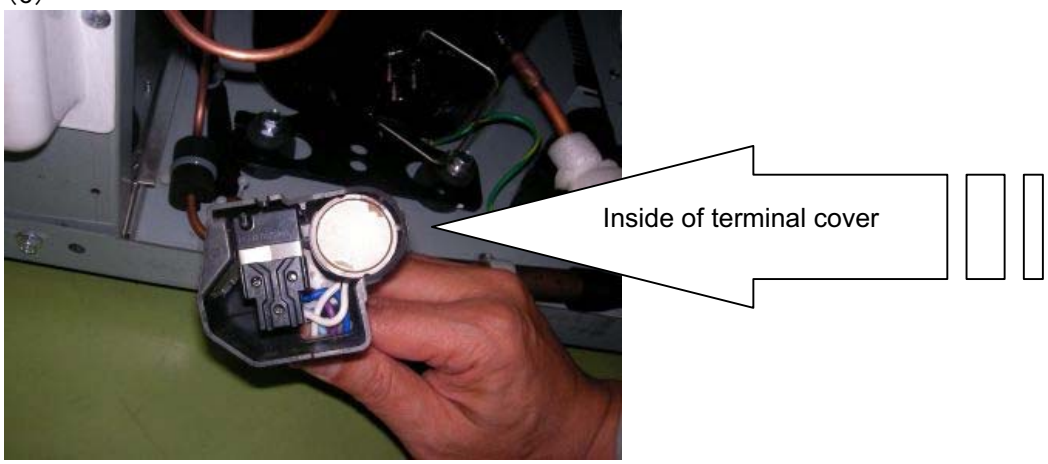
(4)

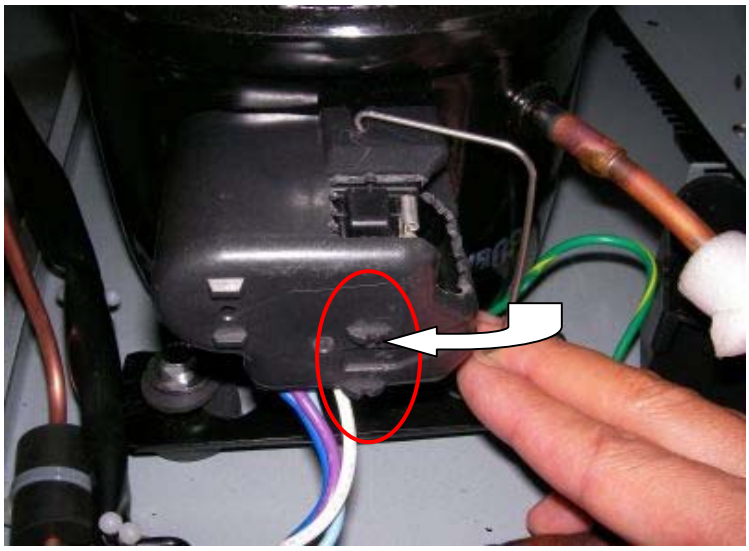


(5)

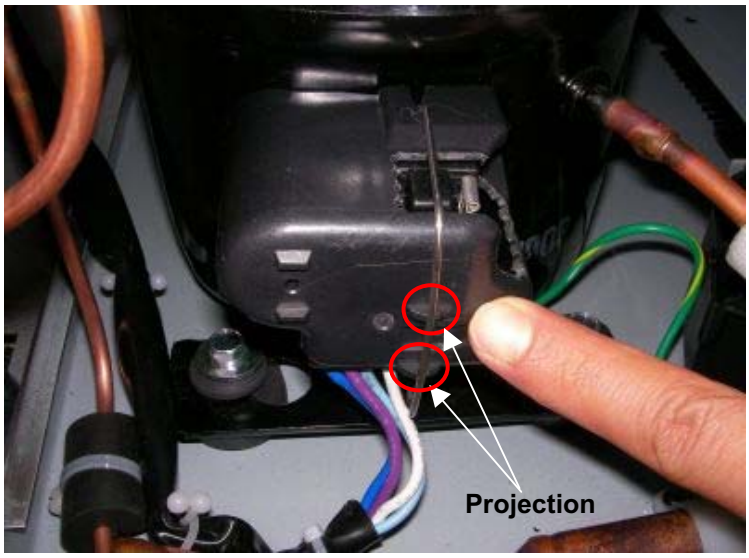
Fit PTC with terminal cover.
Put the projection of terminal cover
in the squarish hole (See picture (4))

(6)





(7)



Mount terminal cover on compressor terminal.
Move the fixing bar back to original position and fix the bar on 2 projections with a snap.

*** For the removal of terminal cover, follow the above process vice versa.

Parts layout

Door hinge cover

Door hinge cover removed

Control panel

Control panel removed

Temperature control sensor cover

Load Line

Temperature control sensor (Loaded)

Entrance of temperature control sensor on the back

Temperature control sensor connector insert

Bend Temperature control sensor to attach load with it

Access port (for recorder sensor)

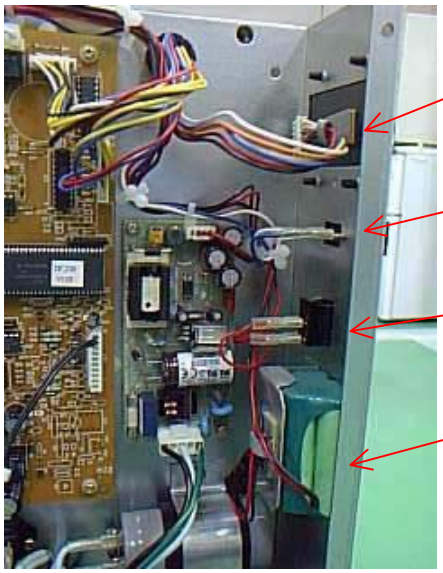
Lock

Connection terminal for Recorder (with socket)

Remote alarm

Battery SW

Power SW



Terminal for MTR-480
(Option)

Remote alarm

Battery SW

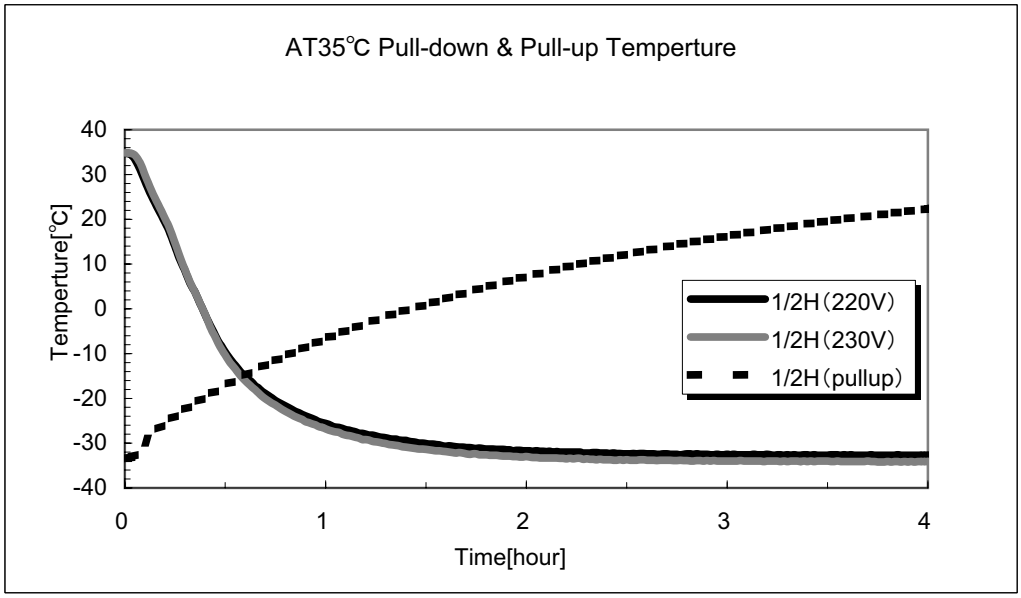
Battery

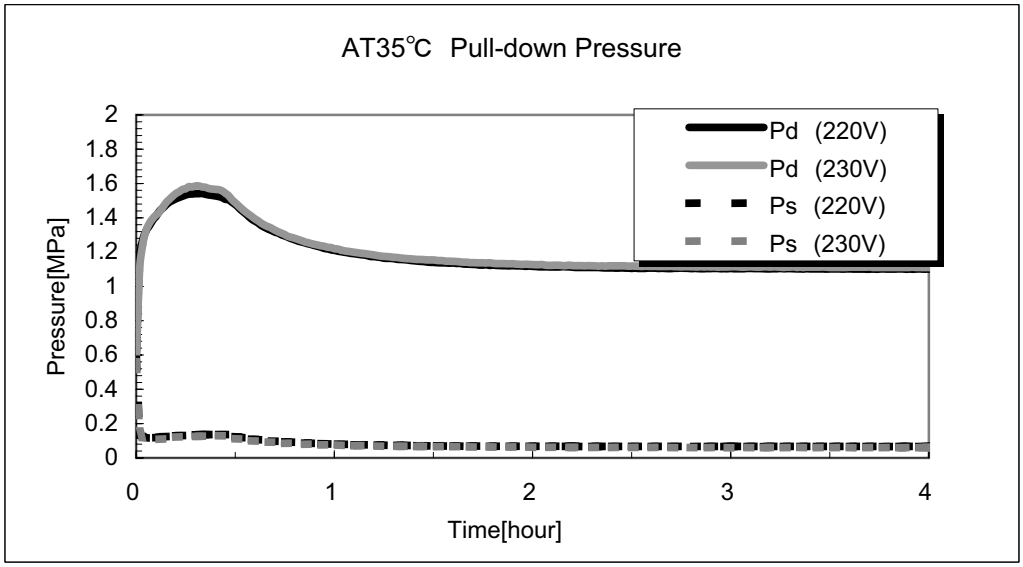
DP1 is lit in power failure alarm

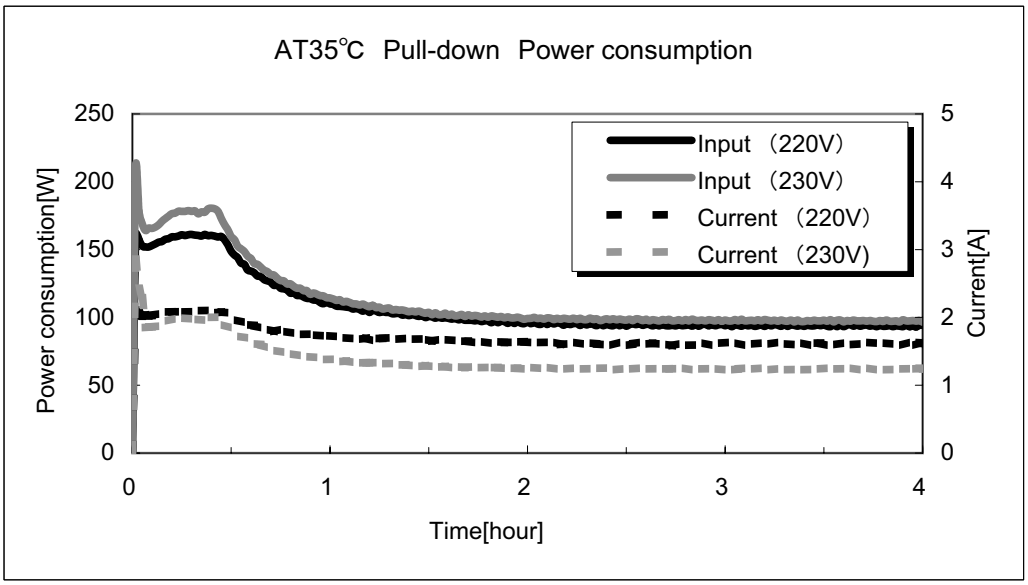
DP2 is lit when compressor is operating

Test data

* All the data are the reference only.

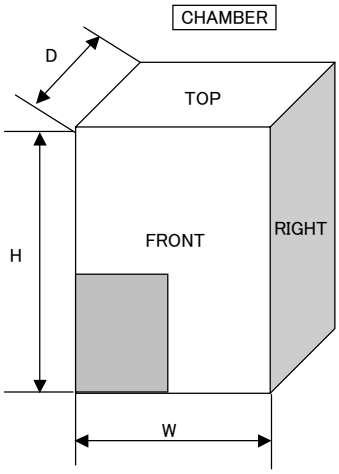


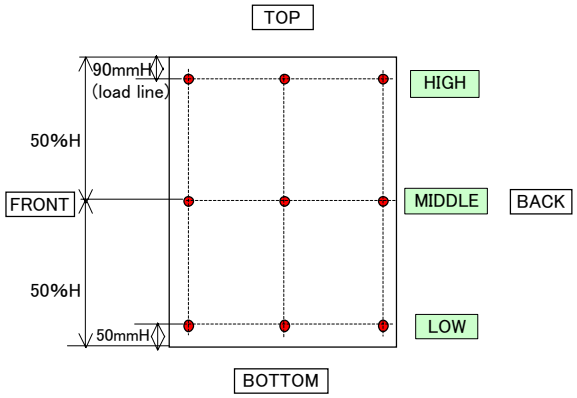


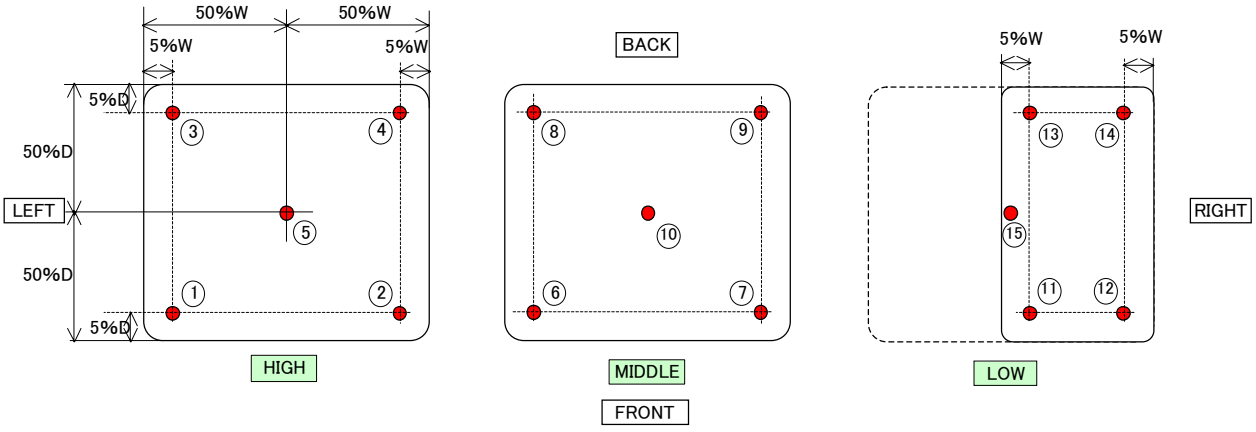


Temperature Uniformity data (15points measured)

*All the data are the reference only.







＜Conditions＞

Ambient temperature: 20/30℃
Load: Unloaded

＜Distribution data＞
Temperature of the cycle in each area (SV=-30℃、air temperature)

Unit:℃

	Ambient temperature 20℃							
	220V50Hz				230V50Hz			
	Maximum	Minimum	Middle of cycle	Differential	Maximum	Minimum	Middle of cycle	Differential
①	-27.8	-29.9	-28.9	±1.1	-27.8	-29.8	-28.8	±1.0
②	-28.1	-31.3	-29.7	±1.6	-28.3	-31.2	-29.8	±1.5
③	-28.1	-31.0	-29.6	±1.5	-28.3	-31.0	-29.7	±1.4
④	-28.1	-31.4	-29.8	±1.7	-28.3	-31.3	-29.8	±1.5
⑤	-28.9	-30.6	-29.8	±0.9	-29.1	-30.6	-29.9	±0.8
⑥	-29.2	-32.5	-30.9	±1.7	-29.4	-32.4	-30.9	±1.5
⑦	-28.9	-32.0	-30.5	±1.6	-29.1	-32.0	-30.6	±1.5
⑧	-28.9	-31.9	-30.4	±1.5	-29.1	-31.9	-30.5	±1.4
⑨	-28.8	-32.1	-30.5	±1.7	-28.9	-32.2	-30.6	±1.7
⑩	-29.6	-31.1	-30.4	±0.8	-29.6	-31.0	-30.3	±0.7
⑪	-29.7	-32.6	-31.2	±1.5	-29.7	-32.7	-31.2	±1.5
⑫	-28.9	-30.6	-29.8	±0.9	-28.9	-30.7	-29.8	±0.9
⑬	-29.5	-31.5	-30.5	±1.0	-29.5	-31.7	-30.6	±1.1
⑭	-28.6	-30.3	-29.5	±0.9	-28.6	-30.4	-29.5	±0.9
⑮	-29.9	-32.0	-31.0	±1.1	-30.0	-32.6	-31.3	±1.3
Average	-	-	-30.1	-	-	-	-30.2	-

Unit:℃

	Ambient temperature 30℃							
	220V50Hz				230V50Hz			
	Maximum	Minimum	Middle of cycle	Differential	Maximum	Minimum	Middle of cycle	Differential
①	-26.2	-28.1	-27.2	±1.0	-26.2	-28.0	-27.1	±0.9
②	-26.7	-29.4	-28.1	±1.4	-26.7	-29.4	-28.1	±1.4
③	-26.7	-29.1	-27.9	±1.2	-26.8	-29.1	-28.0	±1.2
④	-26.8	-29.5	-28.2	±1.4	-26.8	-29.5	-28.2	±1.4
⑤	-27.7	-29.0	-28.4	±0.7	-27.6	-29.0	-28.3	±0.7
⑥	-28.2	-31.0	-29.6	±1.4	-28.1	-31.0	-29.6	±1.5
⑦	-28.0	-30.2	-29.1	±1.1	-27.9	-30.3	-29.1	±1.2
⑧	-27.8	-30.3	-29.1	±1.3	-27.8	-30.4	-29.1	±1.3
⑨	-27.6	-30.7	-29.2	±1.6	-27.6	-30.8	-29.2	±1.6
⑩	-28.5	-30.0	-29.3	±0.8	-28.5	-30.0	-29.3	±0.8
⑪	-28.5	-31.6	-30.1	±1.6	-28.5	-31.6	-30.1	±1.6
⑫	-27.6	-29.4	-28.5	±0.9	-27.5	-29.3	-28.4	±0.9
⑬	-28.5	-31.4	-30.0	±1.5	-28.4	-31.4	-29.9	±1.5
⑭	-27.3	-29.1	-28.2	±0.9	-27.2	-29.1	-28.2	±1.0
⑮	-28.8	-31.9	-30.4	±1.6	-28.8	-31.8	-30.3	±1.5
Average	-	-	-28.9	-	-	-	-28.8	-

Note:This data does not represent a guarantee of product performance.

＜Amount of power consumption＞
Amount of power consumption when driving at cycle (SV=-30℃)

Unit：kWh/day

	Ambient temp 20℃	Ambient temp 30℃
	50Hz	50Hz
220V	1.47	1.87
230V	1.50	1.91
240V	1.55	2.08

Note:This data does not represent a guarantee of product performance.

＜Distribution data＞

Temperature of the cycle in each area (SV=-20℃、air temperature)

Unit:℃

	Ambient temperature 20℃							
	220V50Hz				230V50Hz			
	Maximum	Minimum	Middle of cycle	Differential	Maximum	Minimum	Middle of cycle	Differential
①	-17.5	-20.5	-19.0	±1.5	-17.5	-20.5	-19.0	±1.5
②	-17.7	-21.9	-19.8	±2.1	-17.7	-22.0	-19.9	±2.2
③	-17.8	-21.6	-19.7	±1.9	-17.8	-21.6	-19.7	±1.9
④	-17.7	-22.0	-19.9	±2.2	-17.7	-22.1	-19.9	±2.2
⑤	-18.7	-20.9	-19.8	±1.1	-18.7	-20.9	-19.8	±1.1
⑥	-18.7	-23.0	-20.9	±2.2	-18.7	-23.1	-20.9	±2.2
⑦	-18.7	-22.5	-20.6	±1.9	-18.7	-22.6	-20.7	±2.0
⑧	-18.6	-22.4	-20.5	±1.9	-18.6	-22.5	-20.6	±2.0
⑨	-18.5	-22.7	-20.6	±2.1	-18.5	-22.8	-20.7	±2.2
⑩	-19.3	-21.5	-20.4	±1.1	-19.3	-21.5	-20.4	±1.1
⑪	-19.1	-23.2	-21.2	±2.1	-19.1	-23.3	-21.2	±2.1
⑫	-18.9	-21.3	-20.1	±1.2	-18.9	-21.3	-20.1	±1.2
⑬	-19.1	-23.0	-21.1	±2.0	-19.1	-22.5	-20.8	±1.7
⑭	-18.6	-21.1	-19.9	±1.3	-18.6	-21.0	-19.8	±1.2
⑮	-19.4	-23.5	-21.5	±2.1	-19.4	-23.4	-21.4	±2.0
Average	-	-	-20.3	-	-	-	-20.3	-

Unit:℃

	Ambient temperature 30℃							
	220V50Hz				230V50Hz			
	Maximum	Minimum	Middle of cycle	Differential	Maximum	Minimum	Middle of cycle	Differential
①	-17.4	-20.3	-18.9	±1.5	-17.4	-20.2	-18.8	±1.4
②	-17.5	-21.8	-19.7	±2.2	-17.8	-21.7	-19.8	±2.0
③	-17.8	-21.5	-19.7	±1.9	-17.9	-21.5	-19.7	±1.8
④	-17.7	-22.0	-19.9	±2.2	-17.8	-21.9	-19.9	±2.1
⑤	-18.7	-20.9	-19.8	±1.1	-18.8	-20.9	-19.9	±1.1
⑥	-18.8	-23.3	-21.1	±2.3	-19.0	-23.2	-21.1	±2.1
⑦	-18.8	-22.7	-20.8	±2.0	-18.9	-22.7	-20.8	±1.9
⑧	-18.6	-22.5	-20.6	±2.0	-18.7	-22.5	-20.6	±1.9
⑨	-18.6	-22.9	-20.8	±2.2	-18.7	-22.9	-20.8	±2.1
⑩	-19.5	-21.7	-20.6	±1.1	-19.7	-21.8	-20.8	±1.1
⑪	-19.3	-23.7	-21.5	±2.2	-19.4	-23.7	-21.6	±2.2
⑫	-18.9	-21.5	-20.2	±1.3	-19.0	-21.5	-20.3	±1.3
⑬	-19.2	-23.4	-21.3	±2.1	-19.4	-23.4	-21.4	±2.0
⑭	-18.6	-21.1	-19.9	±1.3	-18.6	-21.1	-19.9	±1.3
⑮	-19.6	-24.0	-21.8	±2.2	-19.8	-23.9	-21.9	±2.1
Average	-	-	-20.4	-	-	-	-20.5	-

Note:This data does not represent a guarantee of product performance.

＜Amount of power consumption＞

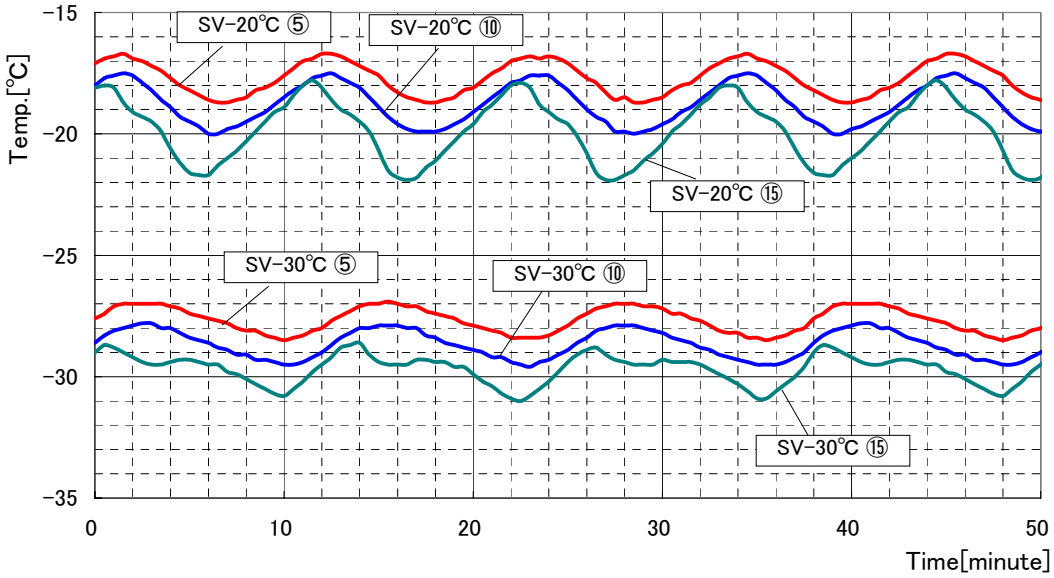
Amount of power consumption when driving at cycle (SV=-20℃)

Unit：kWh/day

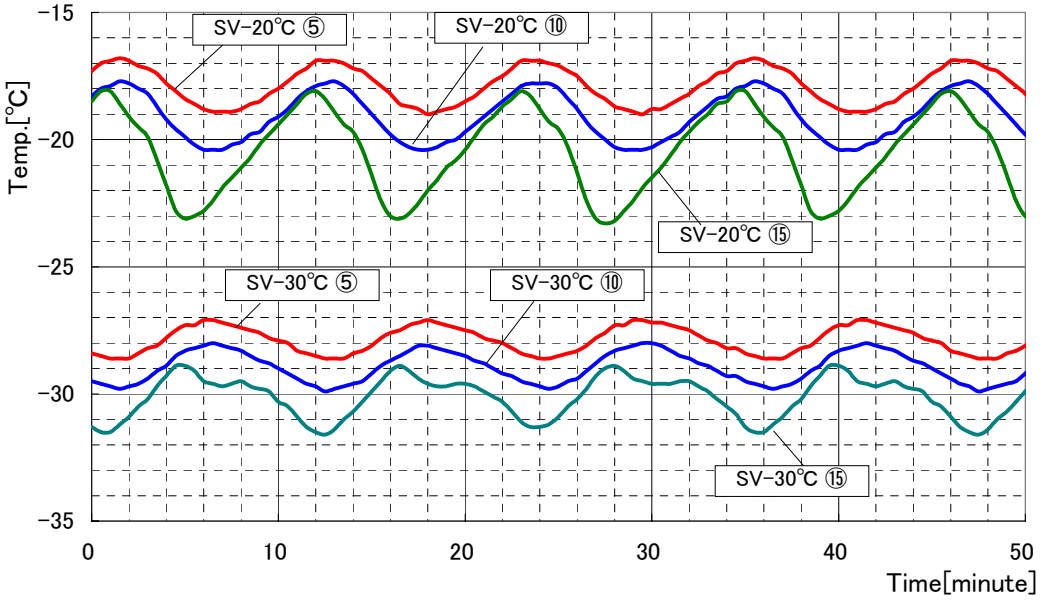
	Ambient temp. 20℃	Ambient temp. 30℃
	50Hz	50Hz
220V	-	1.41
230V	1.07	1.44
240V	1.08	1.48

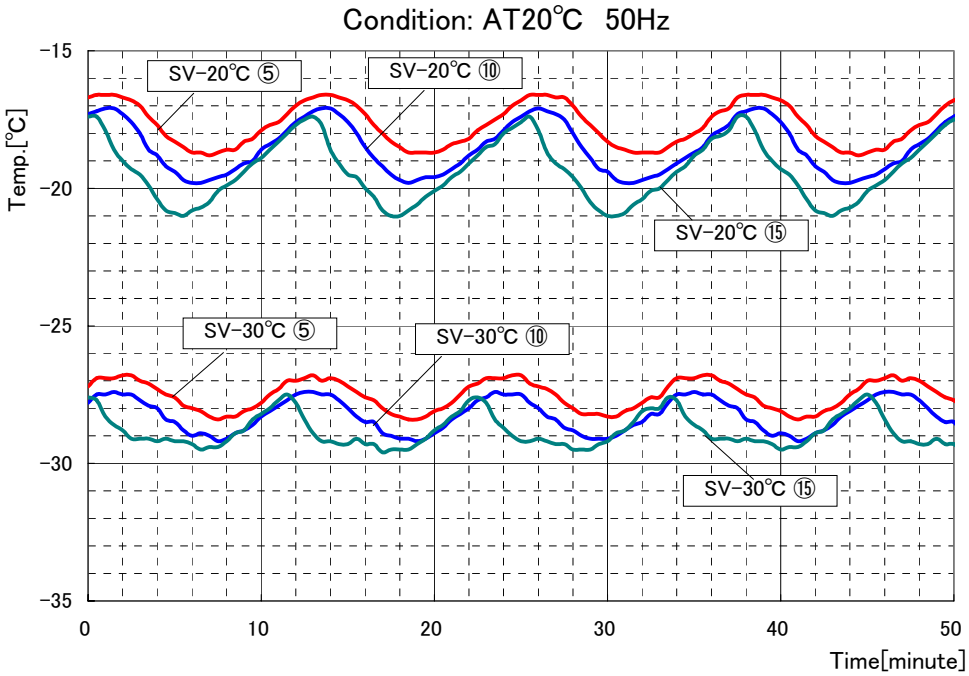
Note:This data does not represent a guarantee of product performance.

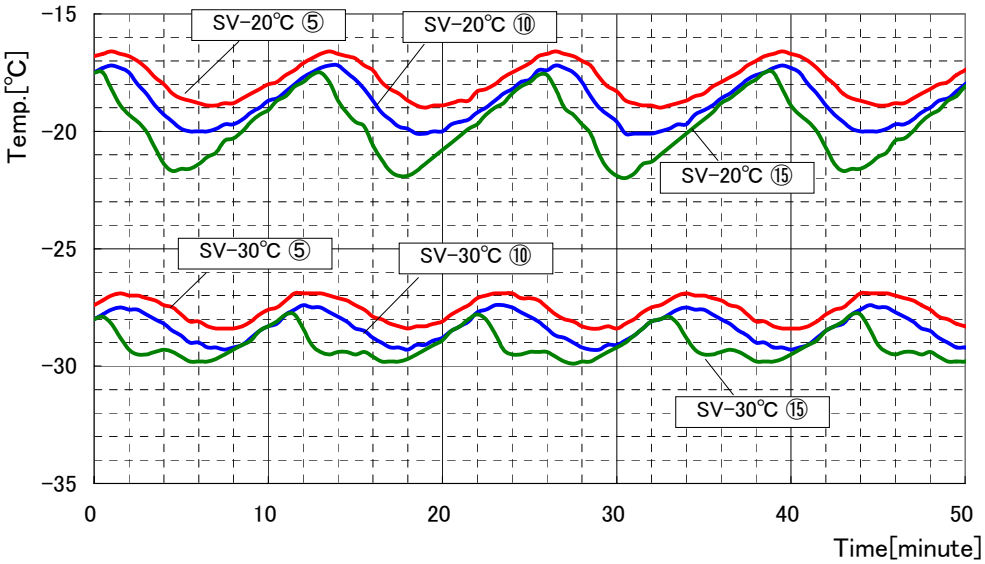
Condition: AT30℃ 50Hz



Condition: AT30℃ 60Hz




Condition: AT20℃ 50Hz
Temp.[℃]
-15
-20
-25
-30
-35
0
10
20
30
40
50
Time[minute]
SV-20℃ ⑤
SV-20℃ ⑩
SV-20℃ ⑮
SV-30℃ ⑤
SV-30℃ ⑩
SV-30℃ ⑮


Condition: AT20℃ 60Hz
Temp.[℃]
-15
-20
-25
-30
-35
0
10
20
30
40
50
Time[minute]
SV-20℃ ⑤
SV-20℃ ⑩
SV-20℃ ⑮
SV-30℃ ⑤
SV-30℃ ⑩
SV-30℃ ⑮